U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-296 952

Air Pollution Over Greater St. Louis

(U.S.) Environmental Protection Agency, Kansas City, MO

Dec 78

PB 296952

United States
Environmental Protection
Agency

Region 7
1735 Baltimore
Kansas City, Mo. 64108

EPA-907/9-78-003
December
1978

Air & Hazardous Materials Division

EPA

Air Pollution Over Greater St. Louis

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

EPA 907/9-78-003

AIR POLLUTION OVER GREATER ST. LOUIS

BY

SEYMOUR L. SHUSTER

ENVIRONMENTAL PROTECTION AGENCY, REGION VII

TABLE OF CONTENTS

Page Number

INTRODUCTION 2

CHAPTER I
What Is Air Pollution? 3

CHAPTER II
What Are The Adverse Effects of Air Pollution? 4

CHAPTER III
What Levels of Air Pollution Are Now Considered Safe? 6

CHAPTER IV
How Will The Air Quality Standards Be Met? 7

CHAPTER V
How Is The Air Quality Over Greater St. Louis Being Measured? 8

CHAPTER VI
How Clean Is The Air Over Greater St. Louis? 15

CHAPTER VII
What Are The Trends In Air Pollution Levels Over Greater St. Louis? 20

SUMMARY 27

ACKNOWLEDGMENTS

The author would like to thank Ms. Tracy Thomas and Mr. Daniel Wheeler for their editorial assistance. Thanks also goes to Ms. Sherry Williams, Ms. Dorothy Hardesty, Ms. Sandra Carpenter and Ms. Jean Amos for their assistance in the preparation of the manuscript.

INTRODUCTION

Since the beginning of the Twentieth Century, man has increased his industrial capacity and mechanical mobility many hundredfold. Along with the blessings of these technological improvements has come an air pollution problem of enormous dimensions. Rates for heart disease, lung cancer, and respiratory ailments like asthma, emphysema and chronic bronchitis, are markedly higher in the densely populated, more heavily polluted urban areas than in suburban and rural areas.

An air pollutant called ozone provides an excellent example of of how rapidly our pollution problems have multiplied in recent decades. Until the early 1940s, ozone was virtually unknown as a public health hazard. It was at that time that, on certain days, Los Angeles was first afflicted with a thick haze. Some thought the haze was caused by smoke; others believed it to be fog. As citizens of other cities had done before them, the people of Los Angeles combined the two words and called the unwelcome intruder "smog."

It was not until a few years later that a scientist was able to duplicate, under laboratory conditions, the hazy Los Angeles atmosphere that brought an epidemic of coughing and eye smarting among the Angelinos. When two air pollutants, hydrocarbons and nitrogen dioxide, were introduced into a sealed chamber into which ultraviolet radiation was emitted, a chemical composition almost identical to the Los Angeles smog was produced. Hence, even though "smog" was proven to be neither smoke nor fog, the name the Angelinos had applied to the phantom haze was nevertheless retained. *Less than 40 years after smog (ozone pollution) first appeared in Los Angeles, the citizens of every American city with a population of more than one-half million have been found to be threatened by this pollutant!*

While scientists differ on the extent to which air pollution can be blamed for the higher incidence of cancer, respiratory ailments and heart disease in urban areas, virtually all agree that the contribution of air pollution is significant. Hence, a major goal of the U.S. Environmental Protection Agency (EPA) working in conjunction with state, county and city agencies has been the reduction and ultimate elimination of the threat to the life and health of American citizens that man-made air pollution has brought.

This report will present a broad overview of air pollution problems as they relate to the United States in general, and to greater St. Louis in particular. This report will acquaint the reader with the St. Louis air pollution situation as it existed in the recent past and as it exists today. The nature of the air pollution over the St. Louis area will be discussed along with the methods being employed to reduce that pollution to an acceptable level. Above all, it is hoped the reader will gain a greater appreciation of the enormous difficulty and complexity of the task that has been undertaken.

As this report will show, air pollution levels in greater St. Louis have appreciably decreased in the last few years. However, the battle is far from won. While primary responsibility for the control of air pollution has been placed in the hands of federal, state, county and city agencies, the job cannot be done without the positive support of every citizen.

An investment in the environment is an investment in which the citizen can, in the near future, realistically expect an ample return. Many of the elderly whose bodies are sensitive to air pollution will require less medical treatment. Less medical treatment for the elderly not only means reduced cost to them, but reduced costs to the taxpayer who supports the Medicaid system. Less air pollution means less crop damage and a cheaper, more abundant food supply.

In the long run, the expense of cleaning our environment will be repaid many times over. It is in these critical times when the return on the investment may not be as apparent as the initial cost that the danger of public apathy is greatest. This danger is not new.

In an article written some years ago, the late Raymond R. Tucker, former Smoke Commissioner and later three-term mayor of the City of St. Louis, wrote:

> *In 1925 a fresh start was initiated . . . the attempt was to be one wherein the general public would be educated to the advantages of the elimination of smoke. A competent staff was employed . . . A firing school was started in the center of the city and instructions were given to individuals in the proper method of firing typical equipment used in St. Louis. While in progress a survey showed that there was a material reduction in the quantity of smoke discharged into the atmosphere. This was not, however, readily apparent to the average citizen. As the campaign tapered off, interest waned and St. Louisans returned to their slovenly habits of firing.*

What was true for the people of St. Louis in 1925 is probably no less true for the general population of the United States today. The biggest danger in our battle against air pollution lies not in our lack of technical expertise or in the lack of possible solutions to our pollution problems, but rather in the possibility that public interest will wane in the course of a long and arduous battle.

CHAPTER I
What is Air Pollution?

Air pollution may be defined as being any substance in the atmosphere that has an adverse effect on man's well-being. The air pollution discussed here comes in three basic forms:

- Solid particles
- Liquid droplets
- Gases

Solid particles and liquid droplets are often lumped together under the general term "particulates." Approximately 100 specific substances have been identified as air contaminants generated by man's activities and there are probably many others that have yet to be discovered.

Among the gases most closely identified as presenting a danger to human health and well-being are:

- Sulfur Dioxide
- Carbon Monoxide
- Hydrocarbons
- Nitrogen Dioxide
- Ozone

Table 1 provides a description of each of these pollutants along with information on their source.

It should be kept in mind that gases like sulfur dioxide and nitrogen dioxide are simply the most prevalent of the sulfur and nitrogen compounds commonly found in our atmosphere. Sulfur trioxide, sulfates, nitrogen oxide, and nitrates all pose a hazard to health.

TABLE 1
DESCRIPTION OF AIR POLLUTANTS AND THEIR SOURCES

Pollutant	Description	Common Sources
Particulates	• Liquid or solid. • Range in size from .05 to 20 millionths of an inch. • Common types of particulates are dust, soil, grain, ash, metal, acid, fiber and mineral.	• Combustion of fuels like coal, oil and gas to generate electricty or space heat. These fuels produce soot and ash (commonly referred to as "smoke"). • Industrial processes. Manufacture of steel and chemicals can generate metal, fiber or acid particulates. • Automobile traffic, unpaved areas, grain storage, and wind and soil erosion generate dust.
Sulfur Dioxide	• Gas. • Colorless but pungent.	• Combustion of any fuel containing sulfur. • Industrial processes such as metal smelting, oil refining or acid manufacturing.
Carbon Monoxide	• Gas. • Colorless, tasteless and odorless.	• Incomplete combustion of gasoline and diesel fuel. • Industrial processes employed in the manufacture of chemicals, metals and in the oil refining industry.
Hydrocarbons	• Gas. • Odorous but colorless.	• Incomplete combustion of gasoline and diesel fuel. • Evaporation of fuel. • Industrial processes employed in oil refining and in large scale painting operations. • Dry cleaning operations.
Nitrogen Dioxide	• Gas. • Reddish-Brown.	• Results from any combustion that takes place in the presence of nitrogen.
Ozone (See notes below)	• Gas. • Visible, odorous and irritating (Looks like fog.)	• Results from chemical reaction that occurs when nitrogen dioxide and hydrocarbons in the atmosphere are exposed to sunlight.

NOTES:

- Ozone is the most common of a family of gases called "oxidants." Another member of the oxidant family which has caused much concern is peroxyacetyl nitrate ("PAN" for short).
- Ozone can be beneficial or harmful to health. The ozone layer that circles the globe at altitudes well above those used by airliners is beneficial to man in that it filters out some of the sun's harmful rays. The incidence of skin cancer and other diseases would probably rise if the ozone layer were damaged by fluorocarbons released at ground level. However, direct contact with ozone can be quite harmful to man.

CHAPTER II

What Are the Adverse Effects of Air Pollution?

There are many ways the body tries to protect itself from contamination by pollutants of all types. However, man-made air pollution has in the last 70 years reached such a magnitude that, in many cases, it can overwhelm the body's defense mechanisms. When these defense mechanisms fail, chronic illness and even death may result.

In the Meuse Valley in Belgium (1930), in Donora, Pennsylvania (1948), in Poza Rica, Mexico (1950), and in London, England (1952), severe, acute air pollution episodes were found to be responsible not only for an alarming increase in the incidence of respiratory ailments and symptoms, but in a sharp increase in the death rate as well. Autopsies performed on the victims of the Meuse, Donora and London air pollution disasters all revealed inflammatory lesions on the lungs that were attributed to the pollution. To be sure, such concentrated pollution levels are unusual, but nevertheless these episodes would have occurred with greater frequency if corrective action had not been taken.

Air pollution poses a threat to the respiratory system, the heart, the nervous system and the eyes. To some extent, the human body can counter the adverse effects of some air pollutants. For instance, the irritating effect upon the eyes of fairly high levels of ozone cause blinking and tearing, which is often sufficient to cleanse the eye of the irritant. Similarly, the nose and trachea are lined with small hair follicles that are capable of capturing the larger particles that enter the respiratory system and help the body expel them. The common cough is simply the body's way of trying to expel an irritant in the throat. However, these defenses were not designed by nature to protect the body against the tremendous onslaught on our environment caused by the industrial revolution. Evolutionary changes in the human body that are designed to assure the survival of the species require thousands of years. It has taken man less than 100 years to saturate his environment with pollution and neither humans, animals or plants are capable of adapting to this rapid build-up in so short a time.

Air pollution is frequently cited as intensifying the effects of, or even causing, heart disease. However, air pollution rarely has a direct effect upon the heart. Any harmful effect air pollution has upon the respiratory system makes it more difficult for it to do its primary job of supplying sufficient oxygen for distribution throughout the body. It is the function of the heart to pump oxygenated blood throughout the body and return it to the lungs so that the waste products (i.e., carbon dioxide) may be expelled and a fresh supply of air be absorbed. When the respiratory system is inhibited from doing its job efficiently, it almost invariably places a strain on the heart because the heart must work harder to supply the body with a sufficient quantity of oxygenated blood. *Therefore, air pollution that attacks the respiratory system often simultaneously puts a strain on the heart.* If heart disease is already present, air pollution can easily cause fatalities. It can also lead to damage to a healthy heart. Of the catastrophic health consequences of air pollution, the role that it plays in the generation of the nation's number one killer—heart disease— may be the most serious of all.

Children are considered to be the group most sensitive to exposure to lead. It has been said that "a picture is worth a thousand words"; anyone who has ever seen a photograph of a child whose brain has been damaged by an excessive exposure to lead will understand the necessity for removing as much lead from our atmosphere as is feasible. The EPA annually receives thousands of complaints from irate automobile owners reluctant to spend the few extra cents per gallon for unleaded gasoline. While unleaded gasoline is also required to protect the catalytic converters on automobiles, sufficient persuasion for using unleaded gasoline might be found in a simple photograph.

The action of two or more stimuli which enhance the effects of each other is called "synergistic" action. In other words, one plus one equals five or even ten. One microgram of sulfur dioxide acting together with one microgram of particulates may have the same effect as five micrograms of sulfur dioxide or ten micrograms of particulates. Just as the synergistic action of alcohol and drugs can result in death, so it is believed that the synergistic action of sulfur oxides and particulates played a major role in the many fatalities that occurred in the Meuse Valley, Donora and London air pollution episodes.

Table 2 provides detailed data on the health effects of the various pollutants.

Air pollution causes other adverse effects on the urban population. These include damage to plants, decreased visibility, weather modification, increased corrosion on buildings, cars, fences, statues and other property. In general, air pollution causes a marked decrease in the attractiveness of our environment.

During the 1920s and 1930s, widespread damage to plants and trees because of air pollution almost resulted in the closing of the Botanical Garden in St. Louis. Land was purchased in Franklin County in anticipation of the pending move. However, in the late 1930s, forceful action by air pollution control authorities to reduce sulfur dioxide and particulate emisions had such a dramatic effect on pollution levels that the move never transpired. To date, that land purchased in Franklin County serves as an arboretum, while the Botanical Garden in St. Louis is as popular an attraction as ever.

The saving of the Botanical Garden required the relatively simple expedient of reducing the quantity of soft coal that was being burned in the St. Louis area at the time.

As recently as October 1978, ozone concentrations rose to unacceptably high levels over an area as distant from St. Louis as Edwardsville, Illinois. The remedy for this and any other ozone problem encountered today over greater St. Louis will be far more complex, expensive and time consuming than the solution to the Botanical Garden problem.

The corrosiveness of certain air pollutants and, to a lesser degree, the erosion caused by particulate matter in motion, take an annual toll in tens of millions of dollars. In the past few years, New York City has spent more than five million dollars on City Hall in Manhattan, and Borough Hall in Brooklyn, just to repair damage caused by air pollution. Peeling house paint, rusting fences, accelerated automobile corrosion, and corrosion of rain gutters, downspouts, and statuary all bear mute testimony to the havoc wrought by air pollution.

Air pollution can damage and fade clothing, curtains and other fabrics. Even if not directly disintegrated by air pollutants, fabrics in polluted atmospheres need more frequent washing or cleaning, adding a dollar cost and shortening the life of the fabric.

One of the most intriguing aspects of air pollution is its effect on weather and climate. The introduction of man-made particulate matter into the atmosphere can alter the cloud-forming process and precipitation patterns.

TABLE 2
HEALTH EFFECTS OF AIR POLLUTANTS

Pollutant	Effect on Humans*	Effect on Plants
Sulfur Dioxide and Sulfur Compounds	• Increased incidence and severity of asthmatic attacks. • Increased incidence of bronchitis and emphysema. • Cause muscle spasm and inflammation of respiratory areas.	• Damages alfalfa, peas, lettuce, sweet potatoes, spinach, pinto beans, pumpkins, oats, carrots, and wheat.
Carbon Monoxide	• Restricts ability of body to absorb oxygen. High concentration is frequently fatal. • Can impair ability of heart to pump blood efficiently. • Limits physical endurance. • Aggravates symptoms of lung disease, anemia, and circulatory diseases.	
Nitrogen Dioxide and Nitrogen Compounds	• Inflame portions of the respiratory system. • Indirect threat to health due to important role in the formation of oxidants.	• Can damage broad leaf plants. • Retards growth of tomato, tobacco and pinto bean plants.
Hydrocarbons	• Indirect threat to health due to important role in the formation of oxidants. • Very high concentrations of hydrocarbons cause acute respiratory ailments.	
Ozone (and PAN)	• Severe irritant to respiratory system (Ozone). • Eye irritant (Ozone).	• Ozone damages tobacco, tomato, bean, spinach, potato, oat, lilac, begonia and white pine. • PAN damages romaine lettuce, pinto beans, tobacco and annual bluegrass.
Particulates	• Danger of particulates depends not only on concentration, but on chemical composition. Certain particulates like asbestos fibers and vinyl chloride dust can cause cancer. • Irritates respiratory system. • Associated with higher incidence of bronchitis. • Potential danger of particulates is greatly increased in the presence of sulfur dioxide.	• Retards plant growth. • Damages plant surfaces.

**In many cases, the suffering of domestic and farm animals from air pollution is similar to that experienced by humans.*

CHAPTER III

What Levels of Air Pollution Are Now Considered Safe?

As we have seen, air pollution presents a hazard to human, animal and plant health and a threat to property as well. Consequently, the Clean Air Act of 1970 required that a set of air quality standards (shown on Table 3), be formulated to protect health and property. The primary standards are levels of air pollution low enough to protect the health of humans, including those most sensitive to its effects—sufferers from respiratory or heart ailments. Secondary standards are levels of pollution low enough to protect animal life, plant life and property.

The target date for the states to meet the primary standards is 1982; however, provisions have been made for any state to request as much as a five year extension in order to meet the carbon monoxide and ozone standards. There is no precise time schedule for meeting the secondary standards; however, they must be attained as soon as practical after attainment of the primary standards.

In October of 1978, the Administrator of the U.S. EPA set an air quality standard for lead. As an air pollutant, this metal falls under the general category of particulate matter, but its existence in our atmosphere has been so pervasive and its effects so threatening to health, that it has become the first non-gaseous element or compound for which standards have been set.
In Table 3, the air quality standards are given in terms of micrograms per cubic meter or parts per million. Using particulate matter as an example, one can better visualize just how minute these pollutant levels can be. The maximum daily permissible average for particulates is given as 260 micrograms per cubic meter. If dust particles were evenly distributed throughout the air of an average sized room (10 x 12 x 8 feet) and the concentration of these particles was equal to the daily maximum allowable (260 ug/m³), the total weight of the dust would be less than three ten-thousandths of an ounce (.0003 ounce). In other words, just a few grains of dust blown out of the hand of a child would be sufficient to saturate the room with the maximum allowable concentration of particulate matter!

TABLE 3
AIR QUALITY STANDARDS

POLLUTANT	TIME OF AVERAGE	PRIMARY STANDARD	SECONDARY STANDARD
		Values are in micrograms per cubic meter (ug/m³) or parts per million (ppm)	
Particulate Matter (TSP)	Annual Geometric Mean 24-hour	75 ug/m³ 260 ug/m³	60 ug/m³ 150 ug/m³
Sulfur Dioxide (SO^2)	Annual Arithmetic Mean 24-hour 3-hour	0.03 ppm (80 ug/m³) 0.14 ppm (365 ug/m³) none	none none 0.5 ppm (1,300 ug/m³)
Carbon Monoxide (CO)	8-hour 1-hour	9 ppm (10,000 ug/m³) 35 ppm (40,000 ug/m³)	Same as Primary Same as Primary
Ozone (O^3)	1-hour	0.08 ppm (160 ug/m³)	Same as Primary
Nitrogen Dioxide (NO^2)	Annual Arithmetic Mean	0.05 ppm (100 ug/m³)	Same as Primary
Non-Methane Hydrocarbons (N-MHC)	3-hour (6 to 9 a.m.)	0.24 ppm (160 ug/m³)	Same as Primary
Lead (Pb)	3-month (Calendar Quarter)	1.5 ug/m³	Same as Primary

1. All standards with averaging time of 24 hours or less are not to be exceeded more than once per year.
2. The ozone standard may, in the near future, be raised to 0.10 ppm (196 ug/m³) or higher.
3. The value shown for non-methane hydrocarbons is not a standard. Rather, it serves as a guideline to help attain the ozone standard.

CHAPTER IV

How Will the Air Quality Standards Be Met?

Under the Clean Air Act, primary responsibility for meeting the air quality standards rests with the states. Each state is required to draw up a detailed plan which provides a step-by-step procedure on just how the state intends to meet the air quality standards. The plan must be approved by the Administrator of the EPA.

Among the most important means being employed by authorities to bring their states into compliance with the air quality standards are:

1. By requiring industrial plants whose emissions into the atmosphere are considered to be excessive, to reduce their emissions to an acceptable level. Some of the more important methods employed by industry to bring their plants into compliance are:

   a. Installation of air cleaning equipment, such as electrostatic precipitators and baghouses to remove particulate matter, and the installation of scrubbers to remove sulfur dioxide;

   b. Use of low-sulfur fuels when feasible;

   c. Modernization of equipment. More efficient means of production often are accompanied by a reduction of pollution. Hence, certain plants are modernizing, changing or eliminating certain processes in order to reduce pollution; and

   d. Use of afterburners and water-based paints to reduce hydrocarbon emissions. Also, new equipment will be installed at refineries and gasoline stations to reduce evaporation losses of hydrocarbons.

2. By reducing automobile emissions. In cities where automobile emissions are excessive, authorities are being required to develop transportation control plans aimed at effectively reducing these emissions. Some of the most important options available to the cities for achieving these goals are by:

   a. Reducing the vehicle miles traveled. This can be accomplished by reducing the cost of bus or train transportation, and providing peripheral automobile parking areas close to bus and train terminals and stations in outlying suburban areas. Bus service can also be improved by minimizing passenger waiting-time during peak hours, having express buses that make only a few stops, designating exclusive bus lanes, making buses as comfortable as possible by minimizing noise, providing air conditioning, etc.;

   b. Encouraging the greater use of carpools and vanpools by making express lanes available to cars and vans with a minimum number of passengers. Bridge, tunnel and highway tolls can also be reduced for car and vanpools;

   c. Effective highway and street planning. This can provide good access to and from commercial and industrial centers. By widening streets, synchronizing traffic lights, and reducing the number of two-way streets, a city could reduce traveling time which, in turn, reduces automotive and bus emissions;

   d. Encouraging industry and commercial institutions to stagger work hours. This can relieve transportation congestion, which causes cars and buses to idle longer, thereby causing greater transportation emissions. By staggering work hours, one also has the advantage of reducing the intense concentration of pollutants during what is referred to as the "peak hours" of 7 to 9 a.m. and 4 to 6 p.m.;

   e. Development of inspection/maintenance programs for automobiles. These programs would require the automobile owner to keep the emission controls on his or her car in optimum or near-optimum operating condition.

CHAPTER V

How is the Air Quality Over Greater St. Louis Being Measured?

Every section of the United States and its territories has been divided into Air Quality Control Regions (AQCR) and each has a numerical designation. The selection of areas to comprise a given AQCR was made on the basis of air pollution problems common to those areas. The greater St. Louis area has been designated as AQCR 070. Figure 1 shows a map of the area along with population figures based on the census of 1970.

Under the Clean Air Act, the individual states have been assigned primary responsibility for the resolution of our air pollution problems. Most states, in turn, have delegated some responsibility for the control of air pollution to local agencies. The jurisdiction of these local agencies usually extends over an individual city or county. Accordingly, responsibility for the acquisition of air quality data and the control of air pollution over greater St. Louis is shared jointly by a number of federal, state and local agencies:

1. U.S. Environmental Protection Agency, Region VII, Kansas City, Missouri, telephone 816-374-3791;
2. U.S. Environmental Protection Agency, Region V, Chicago, Illinois, telephone 312-353-2205;
3. Missouri Department of Natural Resources, Jefferson City, Missouri, telephone 314-751-3241;
4. Illinois Environmental Protection Agency, Springfield, Illinois, telephone 217-782-1830;
5. St. Louis Division of Air Pollution Control, St. Louis, Missouri, telephone 314-453-3334;
6. St. Louis County Department of Community Health and Medical Care, Clayton, Missouri, telephone 314-726-1100; and
7. Granite City Air Pollution Control Board, Granite City, Illinois, telephone 618-451-7636.

It is through individual agency effort and, when necessary, coordination and cooperation with each other, that these agencies strive to resolve our mutual air pollution problems.

The geographical heart of greater St. Louis is bisected by the Mississippi River. Under certain meteorological conditions, a valley tends to concentrate pollution levels in its channel. This is particularly true when a densely populated urban area is located in the valley. Greater St. Louis provides a case in point. The geography of the region in combination with unfavorable meteorological conditions has, on occasion, given rise to unusually high air pollution levels particularly in the City of St. Louis. Usually these conditions result in high levels of ozone or an unacceptably high level of sulfur dioxide acting synergistically with particulates.

As early as the 1950s some air quality monitoring equipment was being operated in St. Louis on a regular basis. Over the years, additional equipment has been added as the EPA, state and local agencies have intensified their efforts to accurately assess the full scope of the air quality problems over metropolitan St. Louis. Today, a wide, sophisticated network of air quality and meteorological instruments is in operation throughout the area. Generally, high population concentration or high pollutant emission rates dictate the location of air pollutant monitoring equipment. In Bond, Clinton, Randolph, and Washington Counties in Illinois, and in Franklin County in Missouri, pollution levels are usually quite low because of the relative absence of pollution sources and sparse population. Hence, these areas are almost totally devoid of air quality monitoring instrumentation.

The monitoring network now operating in greater St. Louis consists of continuous and intermittent equipment. Continuous equipment is designed to work every hour of every day in the year (with the exception of "down-time" for maintenance and calibration checks). Most intermittent equipment operates one full day out of every six.

During 1977 there were at least 14 carbon monoxide, 10 hydrocarbon, 12 sulfur dioxide, 14 ozone, and 12 nitrogen dioxide *continuous* monitoring instruments operating at strategically located sites in the greater St. Louis area. There were also at least 45 particulate, 6 sulfur dioxide, and 6 nitrogen dioxide monitoring instruments operating *intermittently*. In addition, there were numerous instruments monitoring meteorological data like wind direction, wind speed, temperature, pressure and relative humidity. Location and type of equipment used may vary from year to year, depending on monitoring needs.

All this equipment is operated by state or local agencies on a regular basis. In an effort to reduce costs and improve efficiency in the acquisition and processing of continuous data, the air pollution control authorities for the City and County of St. Louis have integrated their monitoring networks and can telemeter results from continuous monitors to their offices for instantaneous readout.

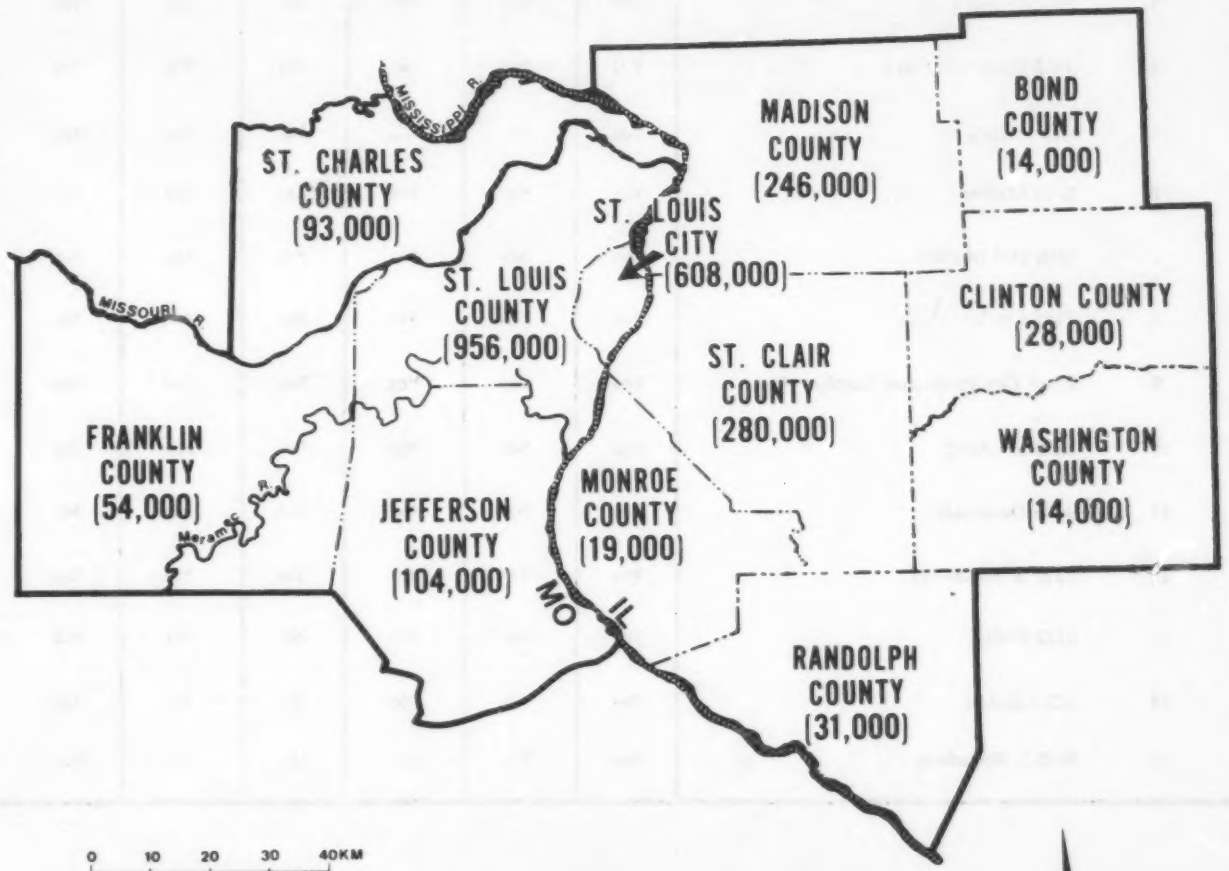
In addition to the instruments discussed above, there are also monitors operated by private corporations and universities, and equipment used for specialized, generally short-term studies.

Figure 2 shows the location of air quality monitoring sites that were operating in the *City of St. Louis* in 1977. The address of each site and the air quality monitoring equipment in operation at that site are shown on Table 4.

Figure 3 shows the general area where one or more sites were operating in the *remainder of the St. Louis area* during 1977. Table 5 shows the address of each site and the air quality equipment that operated on the Illinois side. Table 6 provides the same information for the remaining sites on the Missouri side.

Figure 1

St. Louis Air Quality Control Region 070



EPA REGION 7

TABLE 4
AIR QUALITY MONITORING EQUIPMENT IN THE CITY OF ST. LOUIS

Map Designation	Site Address	Pollutants Monitored					
		Particulates	Sulfur Dioxide	Nitrogen Dioxide	Ozone	Carbon Monoxide	Hydro-Carbons
1	Chain of Rocks Water Dept.	Yes	Yes	Yes	Yes	Yes	Yes
2	Gimblin Pumping Station	Yes	No	No	No	No	No
3	Shreve and I-70	Yes	Yes	Yes	Yes	Yes	Yes
4	1400 Shawmut Place	Yes	No	No	No	No	No
5	Grand Laclede	Yes	No	No	No	No	No
6	1720 Market	Yes	Yes	Yes	No	No	No
7	14th and Market	Yes	No	No	No	No	No
8	1122 Clark	Yes	Yes	Yes	No	No	No
9	River Des Peres and Sulphur Ave.	Yes	Yes	Yes	Yes	Yes	Yes
10	3500 S. Grand	Yes	No	No	No	No	No
11	4408 Donovan	Yes	No	No	No	No	No
12	8227 S. Broadway	Yes	Yes	Yes	Yes	Yes	Yes
13	8122 Reilly	Yes	No	No	No	No	No
14	322 Catalan	Yes	No	No	No	No	No
15	8645 S. Broadway	Yes	No	No	No	No	No

Figure 2

Location of Air Monitoring Sites in City of St. Louis

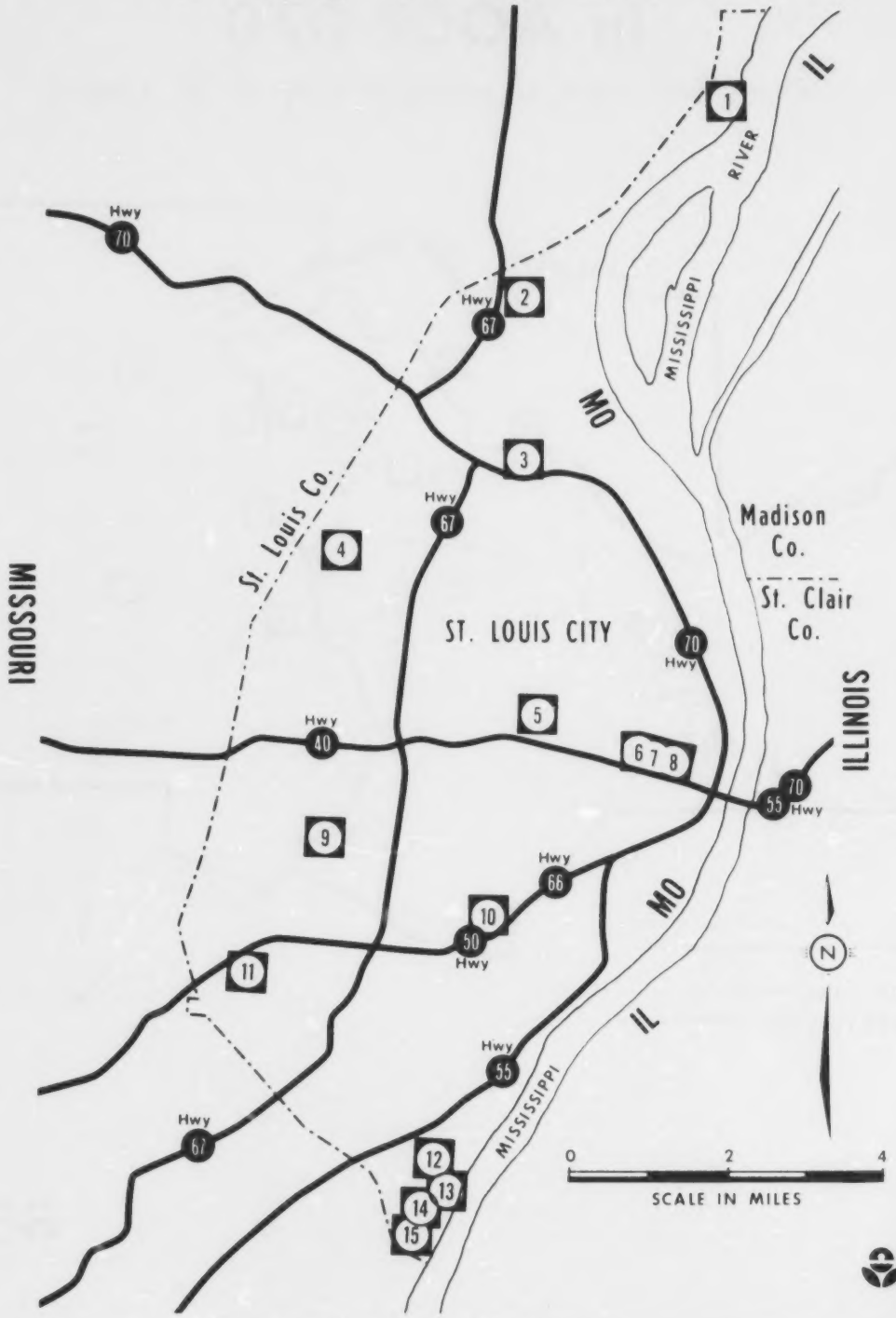
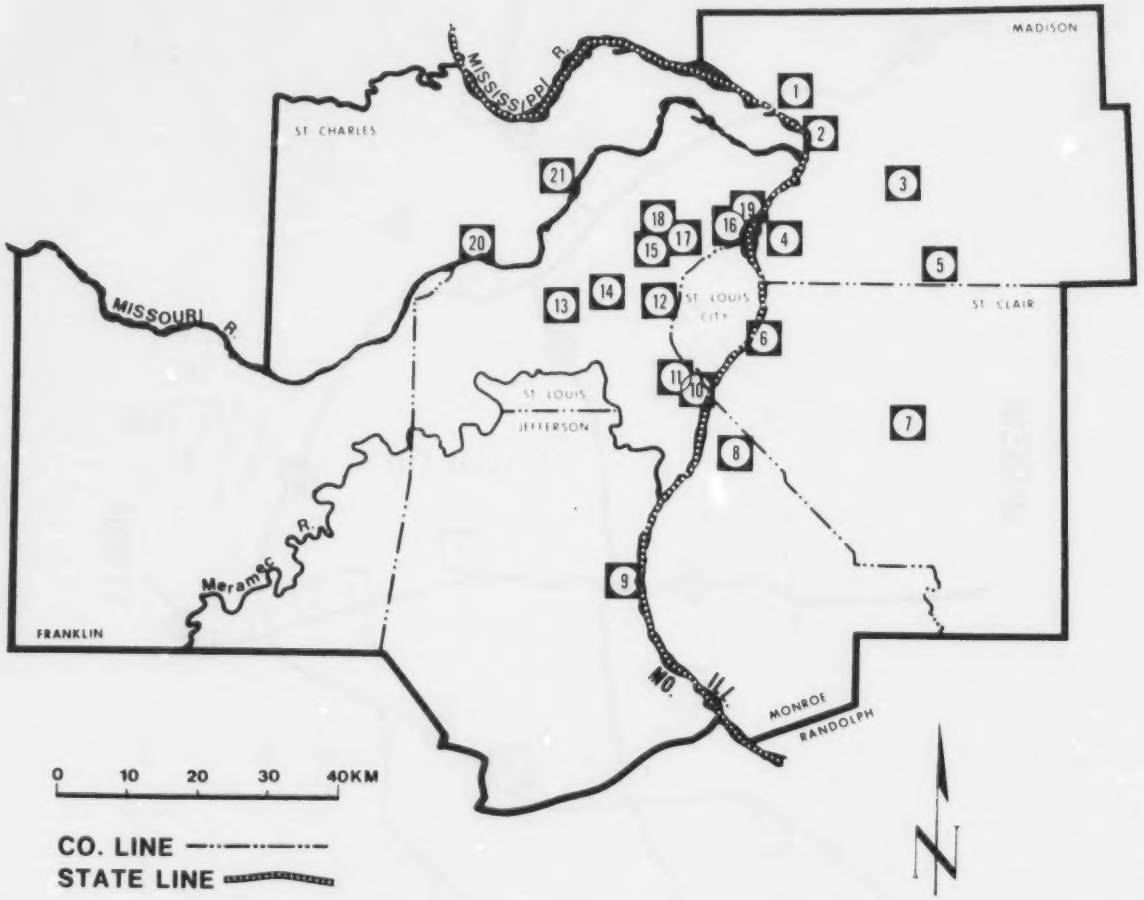


Figure 3

Location of Air Monitoring Sites in AQCR 070

(Does Not Include Sites in City of St. Louis)



EPA
Region 7

TABLE 5
AIR QUALITY MONITORING EQUIPMENT OPERATING ON ILLINOIS SIDE

Map Designation	Site Address	Pollutants Monitored					
		Particulates	Sulfur Dioxide	Nitrogen Dioxide	Ozone	Carbon Monoxide	Hydrocarbons
1	ALTON						
	103 East Third Street	Yes	No	No	No	No	No
	1616 Joesting	Yes	Yes	Yes	Yes	No	No
2	WOOD RIVER						
	54 West Walcott	Yes	Yes	Yes	Yes	Yes	No
3	EDWARDSVILLE						
	132 North Kansas	Yes	No	No	No	No	No
4	GRANITE CITY						
	2000 Edison	Yes	Yes	Yes	No	No	No
	23rd and Madison	Yes	No	No	No	No	No
	3201 East 23rd Street	Yes	No	No	No	No	No
	2001 East 20th Street	Yes	No	No	No	No	No
	15th and Madison	Yes	No	No	No	No	No
	Roosevelt and Rock Road	Yes	No	No	No	No	No
	Lincoln and Nameoki	Yes	No	No	No	No	No
	Norfolk and Western	Yes	No	No	No	No	No
5	COLLINSVILLE						
	115A West Main	Yes	No	No	No	No	No
6	EAST ST. LOUIS						
	7 Collinsville Avenue	Yes	No	No	No	No	No
	Business Route 40 (Cahokia Mounds)	Yes	Yes	Yes	Yes	Yes	No
	650 Missouri	No	Yes	Yes	Yes	Yes	No
7	BELLEVILLE						
	101 South Illinois	Yes	No	No	No	No	No
8	COLUMBIA						
	208 South Rapp	Yes	No	No	No	No	No

TABLE 6

AIR QUALITY MONITORING EQUIPMENT OPERATING ON MISSOURI SIDE (OUTSIDE OF CITY OF ST. LOUIS)

Map Designation	Site Address	Pollutants Monitored					
		Particulates	Sulfur Dioxide	Nitrogen Dioxide	Ozone	Carbon Monoxide	Hydrocarbons
9	HERCULANEUM Dunklin High School	Yes	Yes	No	No	No	No
10	LEMAY 8900 South Broadway 9101 South Broadway	Yes Yes	No No	No No	No No	No No	No No
11	AFFTON 5962 South Lindbergh	Yes	Yes	Yes	Yes	Yes	Yes
12	CLAYTON 55 Hunter 801 South Brentwood	No Yes	Yes No	Yes No	Yes No	Yes No	Yes No
13	QUEENY PARK 305 Weidman Road	Yes	Yes	Yes	Yes	Yes	Yes
14	BELLEFONTAINE Ladue and Olive	Yes	No	No	No	No	No
15	ST. ANN 10267 St. Charles Rock Road	Yes	Yes	Yes	Yes	Yes	Yes
16	PLEASANT HILL Lilac and Scenic	Yes	No	No	No	No	No
17	FERGUSON 3400 Pershall Road	Yes	No	No	No	No	No
18	BERKELEY 8811 Harold Drive	Yes	No	No	No	No	No
19	BELLEFONTAINE NEIGHBORS 805 Chambers Road I-270 and Route 67	Yes Yes	No Yes	No Yes	No Yes	No Yes	No Yes
20	WELDON SPRINGS Highway 94 - 4.5 miles South of U.S. Route 40	No	Yes	Yes	Yes	Yes	No
21	ST. CHARLES 2817 Elm Street	Yes	Yes	Yes	Yes	Yes	Yes

CHAPTER VI

How Clean Is The Air Over Greater St. Louis?

At the present time the greater St. Louis area is considered to be in compliance with the air quality standard for only one of the five primary pollutants: nitrogen dioxide. In varying degrees, problem areas for total suspended particulates, sulfur dioxide, carbon monoxide and oxidants, still exist.

Particulates

The shaded portion of Figure 4 shows those areas that have not attained the primary or secondary standards for particulate matter (total suspended particulates). We can see that most of the area in violation of the primary standard is not among the more densely populated portions of greater St. Louis. Note also that two isolated areas (sometimes called "hot spots") are also in violation of the secondary standards. These areas are around the towns of St. Ann in St. Louis County, and Herculaneum near the Mississippi River in Jefferson County.

Sulfur Dioxide

Figure 5 shows that only one area in greater St. Louis is not considered to have achieved the air quality standard for sulfur dioxide. This sulfur dioxide "hot spot" covers the southern tip of the City of St. Louis and a small, adjacent portion of St. Louis County. Steps have been taken to eliminate this "hot spot." Continuing sulfur dioxide monitoring of that area in 1978 indicates compliance with the standards has recently been achieved. It is expected that the entire St. Louis area will be declared to be in compliance with the sulfur dioxide standards in the near future.

Carbon Monoxide

As can be seen in Figure 6, the entire City of St. Louis and the areas of St. Louis County adjacent to the city are in violation of the carbon monoxide standards. The remainder of the area has attained the standards. Probably, as older cars are replaced by new ones and an effective transportation control plan has been fully implemented, the entire area will achieve the standard for carbon monoxide.

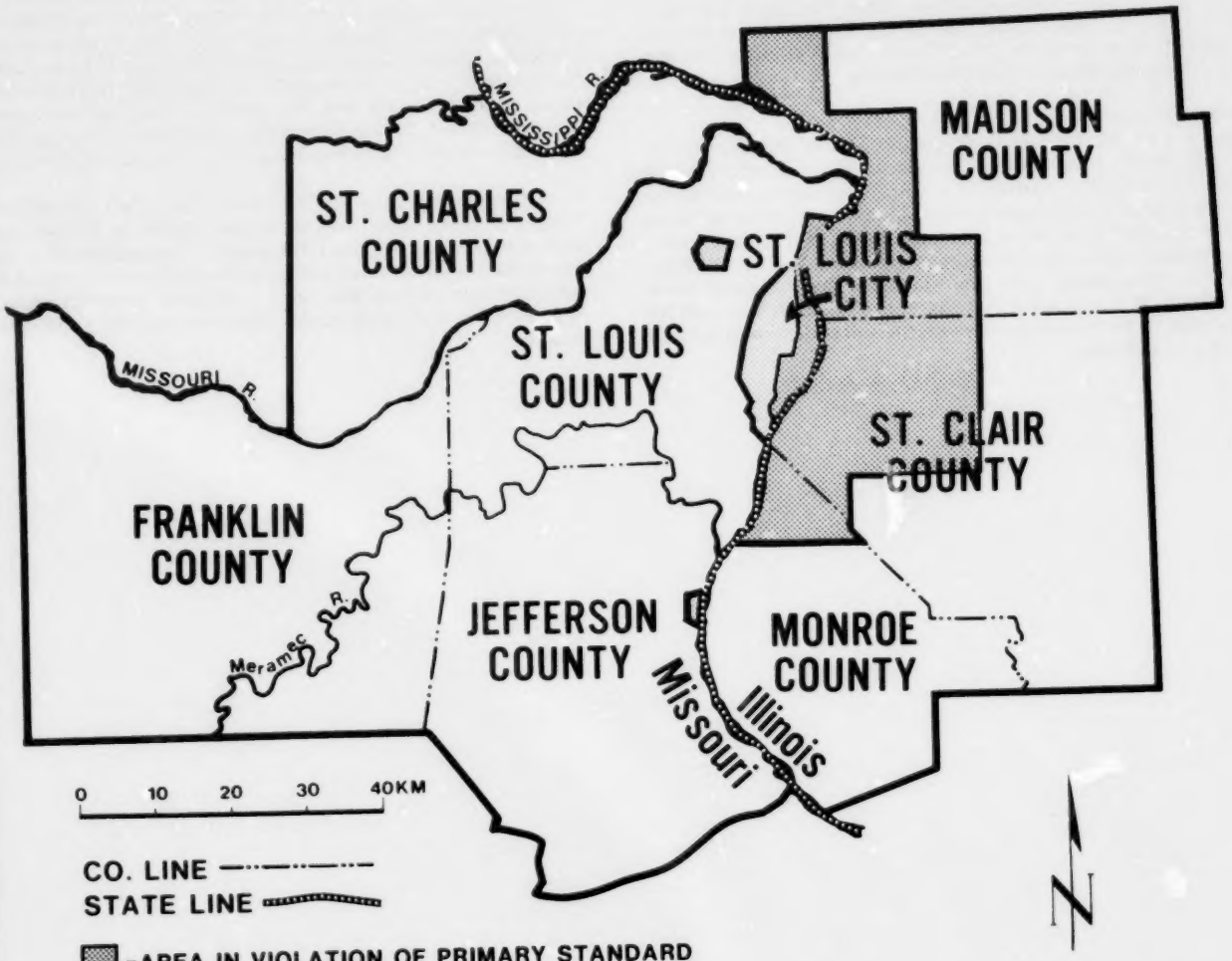
Ozone

A "major urban area" is defined as one where the population is greater than 200,000. There are 105 such urban areas in the United States today and only two of these (Spokane, Washington, and Honolulu, Hawaii) are not considered to have an ozone problem. All other urban areas have been found to have ozone levels that threaten either health or property. Figure 7 shows those counties in this area that are in violation of the ozone standard. (Bond, Clinton, Randolph and Washington Counties in Illinois are considered to have achieved the ozone standard.)

As previously noted, ozone is produced by a chemical reaction that takes place when two pollutants (nitrogen dioxide and hydrocarbons) are exposed to sunlight. The attainment of the ozone standards will require the implementation of an effective transportation control plan and a concrete effort to reduce hydrocarbon and nitrogen dioxide emissions from industrial sources.

Figure 4

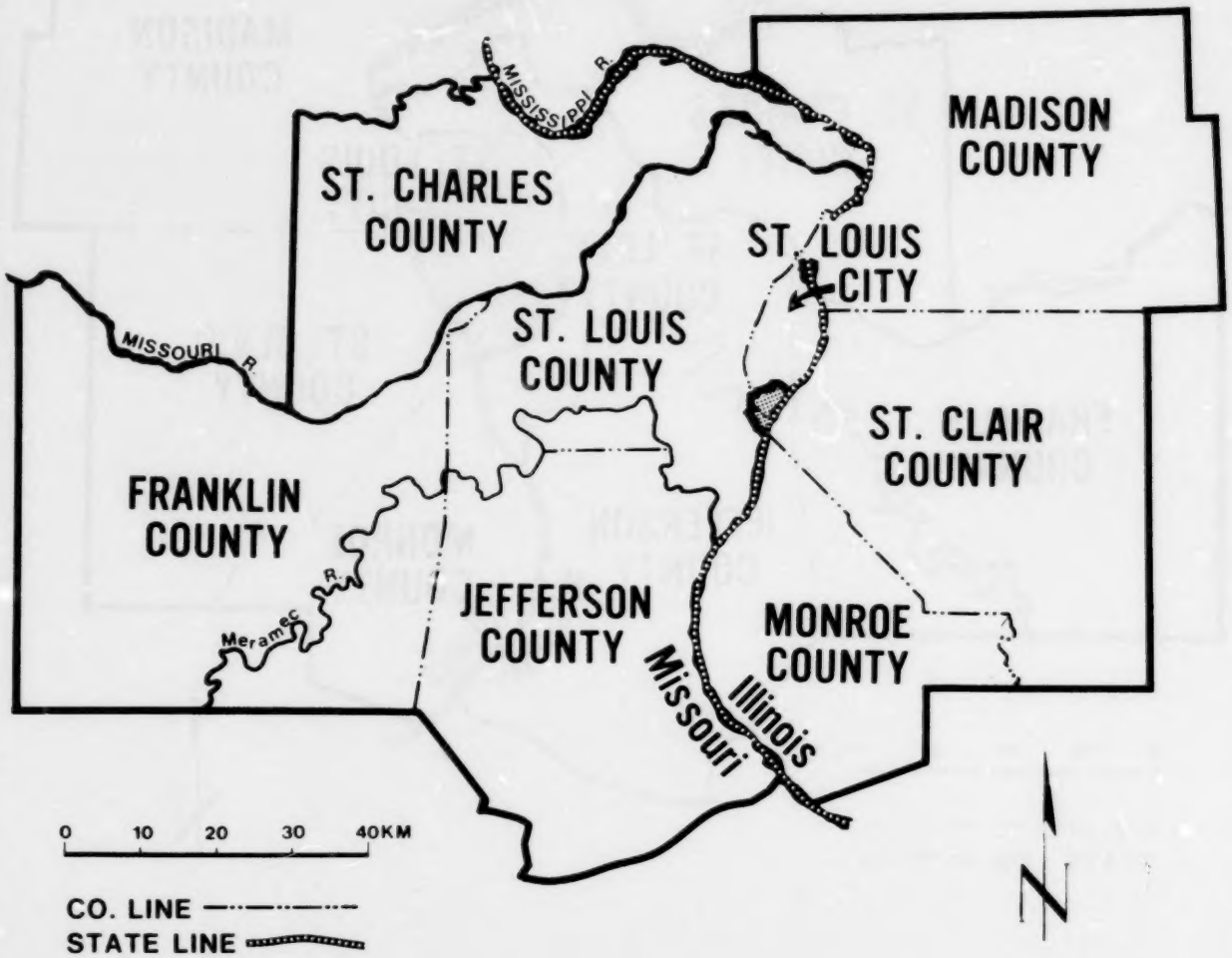
Particulate Nonattainment Areas



EPA
Region 7

Figure 5

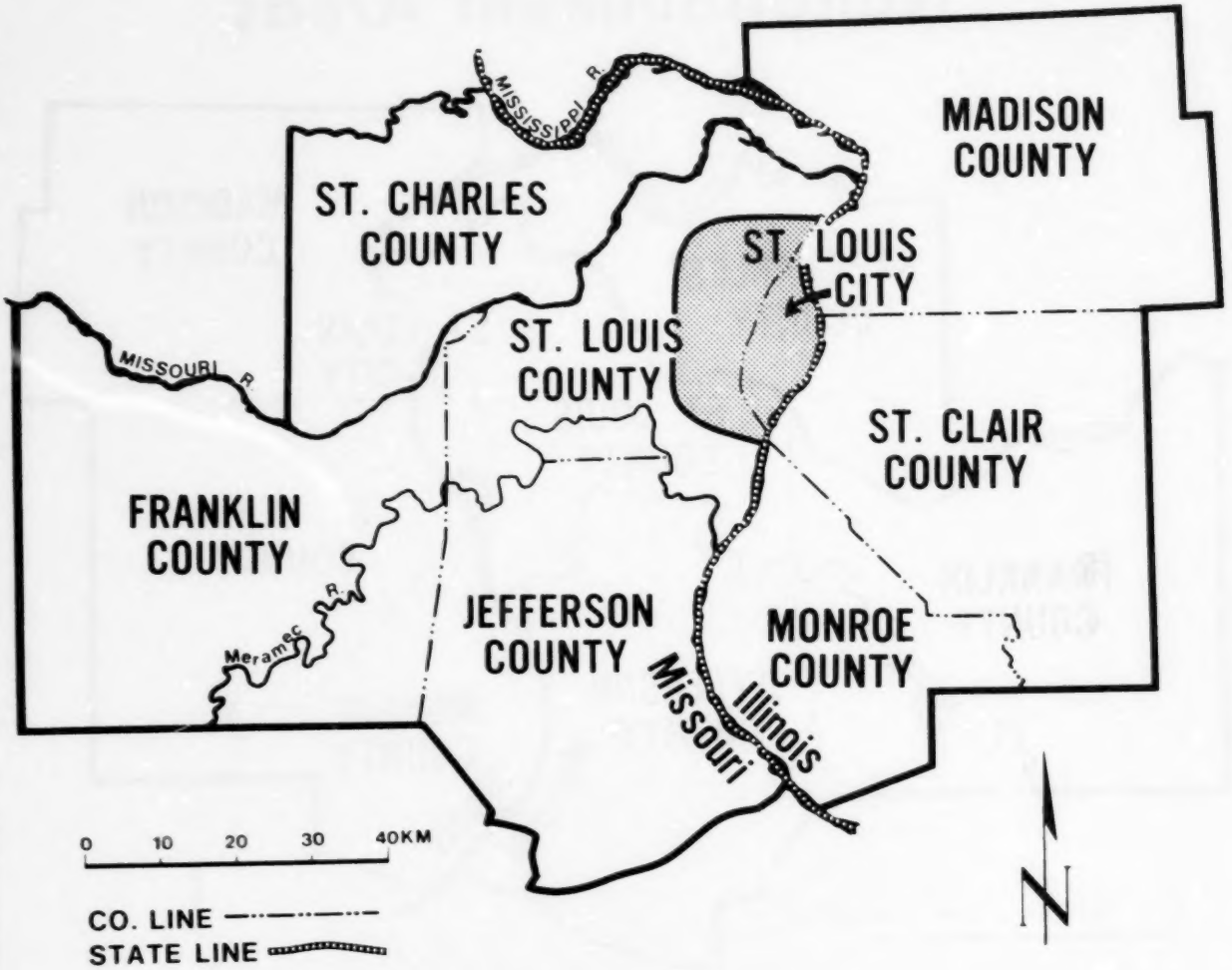
Sulfer Dioxide Nonattainment Areas



EPA
Region 7

Figure 6

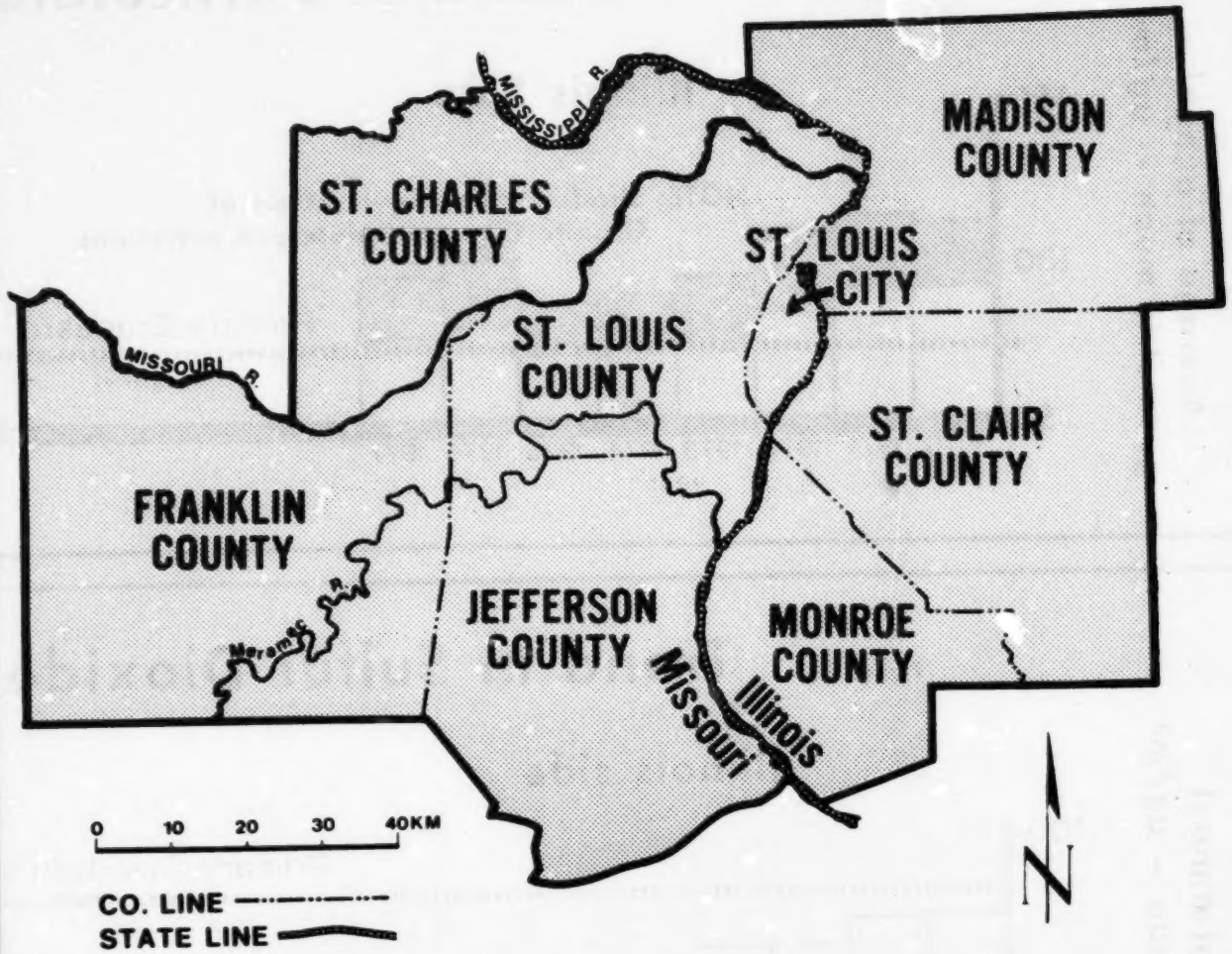
Carbon Monoxide Nonattainment Area



EPA
Region 7

Figure 7

Ozone Nonattainment Areas



EPA Region 7

CHAPTER VII

What Are The Trends in Air Pollution Over Greater St. Louis?

The U.S. EPA review of trend data reveals a steady decline in particulate and sulfur dioxide levels. Electric generating power plants and factories are the prime sources of these two pollutants. Trend data shown in Figures 8 and 9 reflect the effectiveness of the efforts of the state and local agencies to reduce public exposure to these pollutants. Figure 8 shows the trend of particulate levels for three subdivided portions of the greater St. Louis area. (Insufficient data exists for the Missouri side (City of St. Louis excepted) to show averages for 1970.) However, downward trends on the Missouri side of the greater St. Louis area are readily apparent.

More serious particulate problems exist on the Illinois side and are concentrated in the Granite City area of Madison County. The solid shading shown on the bar graph for the Illinois side represents the influence of the Granite City area on particulate levels. Note that by excluding Granite City data, composite

Figure 8

Trend in Particulate

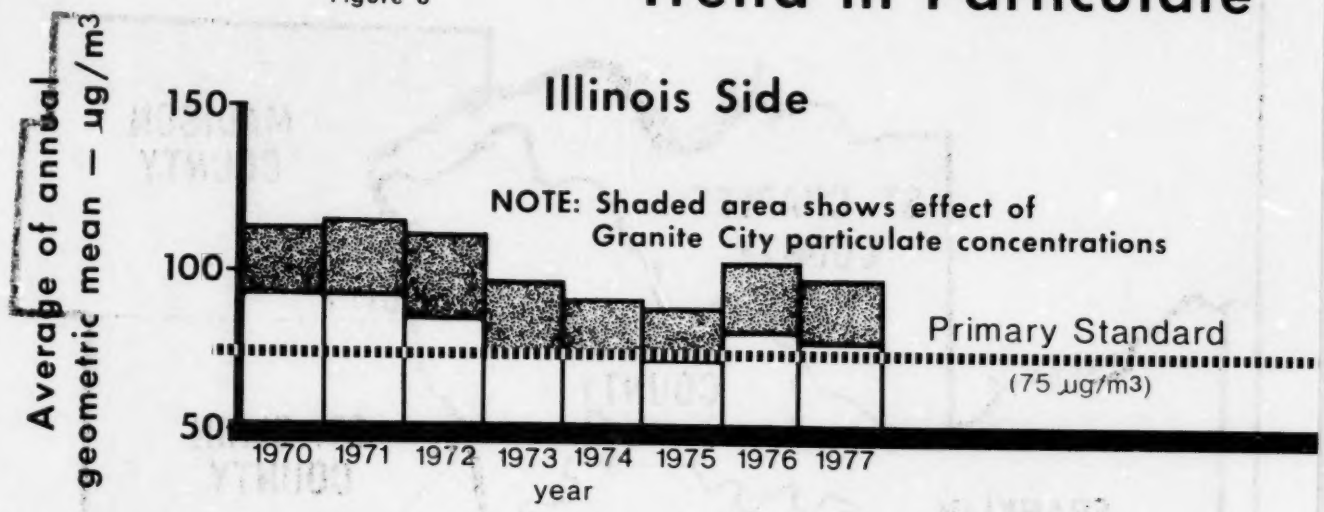
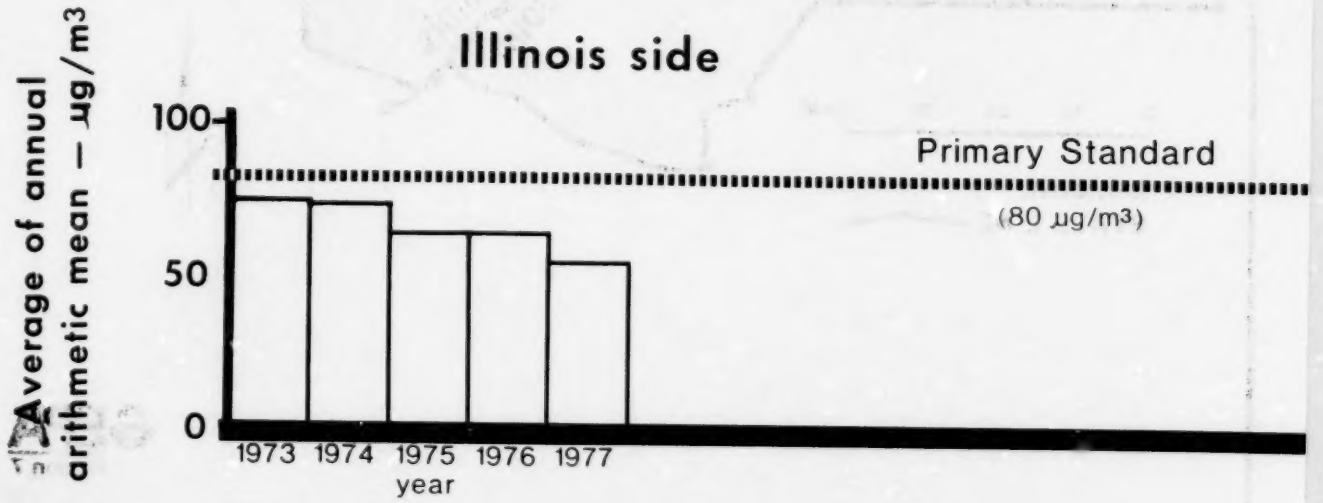


Figure 9

Trend in Sulfur Dioxide

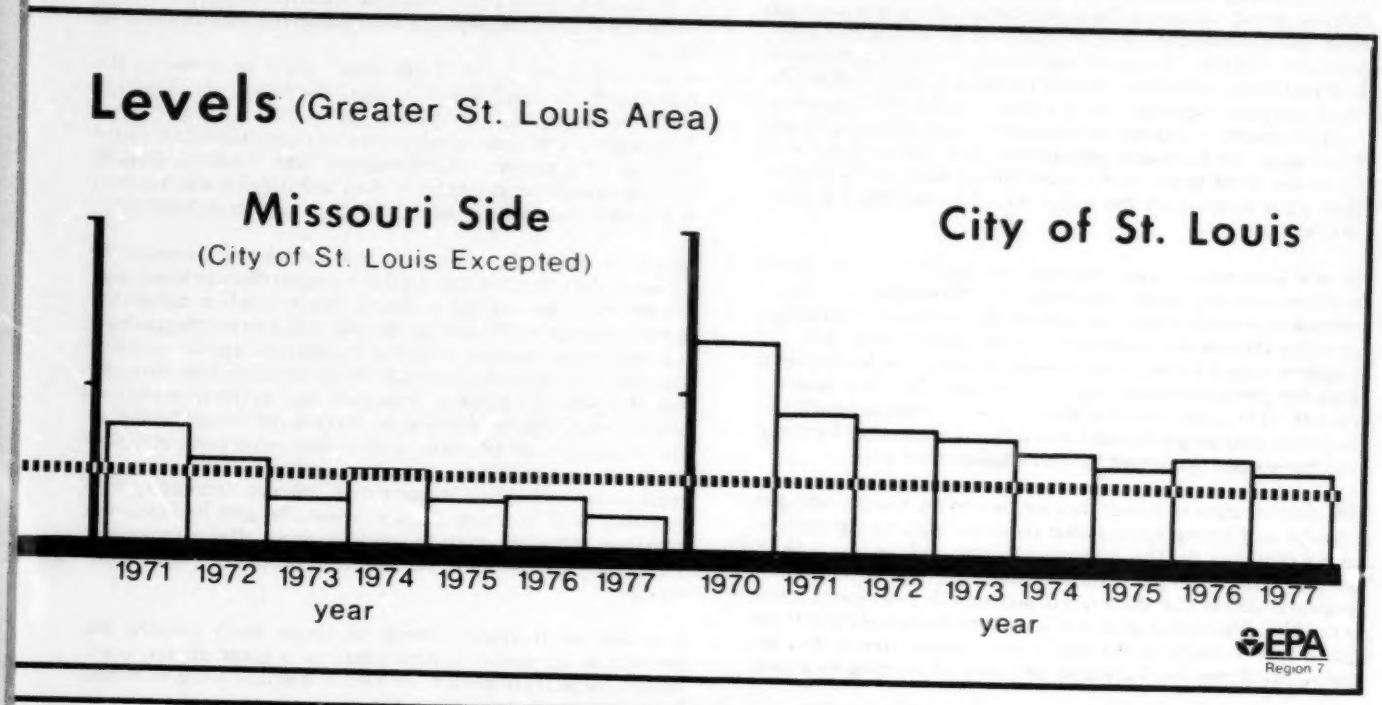


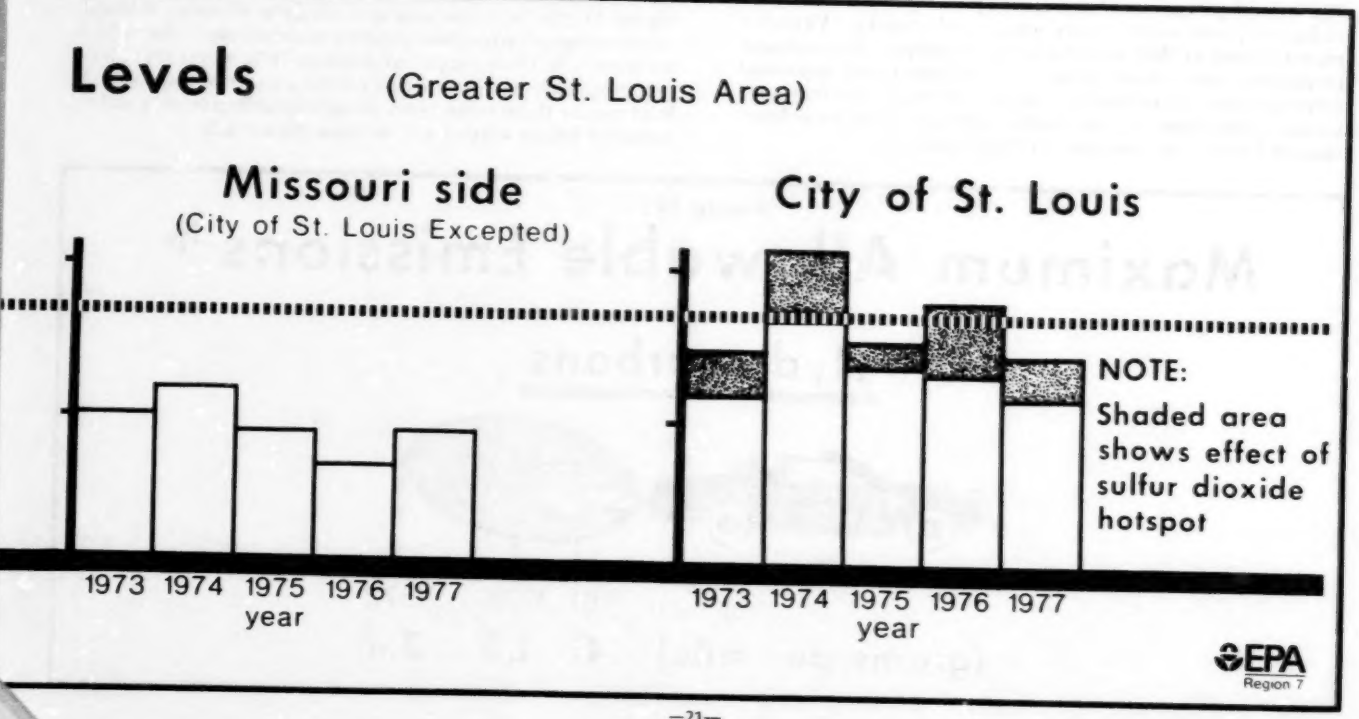
particulate levels on the Illinois side have been very close to the primary standard for the last five years.

These downward trends will probably continue as more industrial facilities come into compliance with state and federal particulate emission regulations. However, more stringent emission regulations may be needed to reach and maintain the air quality standards in all portions of the area. Note that when a composite annual average is below the standard, it does not necessarily mean that the area has attained that standard. Attainment is achieved only when each site in the area records averages that are below the standards.

Particulate concentrations are greatly affected by meteorological conditions such as wind velocity and rainfall levels. A preliminary study conducted by Region VII of the U.S. EPA tended to confirm the widespread belief that drought conditions in the Midwest were largely responsible for elevated particulate levels recorded in 1976. The effects of this drought in 1976 are also apparent in Figure 8.

Figure 9 shows composite averages of sulfur dioxide levels in the three subdivided portions of the greater St. Louis area during 1973-77.





The darkened areas of the graph for the City of St. Louis show the effects of the site located in the sulfur dioxide "hot spot" in the southern end of the city. Note that when the shaded area is excluded, the composite averages all drop below the primary standard.

For the remaining areas on the Missouri side (outside of St. Louis), composite averages have always been well below the primary standard of 80 micrograms per cubic meter for sulfur dioxide.

The situation on the Illinois side is somewhat ambiguous. As one can see, trend data are quite encouraging: composite averages have not exceeded the primary standard in the last five years. Yet, sulfur dioxide "hot spots" were known to exist in the towns of Wood River and Alton. The major sulfur dioxide polluters in these two townships have made a concentrated effort to reduce their emissions in a variety of ways and results are being closely monitored. Until a clearer picture emerges, a determination of the status of the towns of Alton and Wood River with regard to their compliance with the sulfur dioxide standards has been delayed.

As was previously noted, stationary sources like power plants and factories are most responsible for particulate and sulfur dioxide emissions. Hence, a substantial reduction in particulate or sulfur dioxide emissions from a large factory in St. Ann, for instance, would be reflected in reduced pollutant levels in that area, but generally would not result in noticeably lower levels in the City of St. Louis or on the Illinois side of the Mississippi River. So trends data for particulates and sulfur dioxide were localized and have been presented for three subdivided areas.

The presentation of trends data for carbon monoxide, nitrogen dioxide and ozone is somewhat different than for particulates and sulfur dioxide. This is because motor vehicles play a much greater role in the generation of these pollutants. Substantial improvement in the efficiency of automobile emission controls would be reflected in an overall lowering of levels of these three pollutants throughout the entire area. Hence, trends data are being presented for the entire area instead of being localized.

The federal government has retained primary responsibility for reducing emissions from cars and trucks. Vehicles manufactured in 1968 were the first to be subjected to emission limitations, which have grown more stringent with improved emission control technology. Figure 10 shows the very substantial reductions in automobile emissions that have been required over a ten-year period (1972-1981).

Figure 11 reflects a downward trend in carbon monoxide levels since 1972. In 1972-73 more than two-tenths of one percent of the readings taken showed a violation of the eight-hour standard. By 1977, less than one-tenth of one percent violations were recorded. An obvious break in the downward trend of carbon monoxide violations occurred in 1976. The percentage of violations was nearly twice that of the preceding and the following years. A check of the data from each of the sites indicates this increase was general and not attributable to only one or two instruments. The U.S. EPA can find no reason for this sudden increase in carbon monoxide violations though three possibilities are suggested:

1. Unusual weather conditions characterized by very low wind velocities might have permitted a build-up of carbon monoxide levels; or
2. Unusual amounts of construction close to some of the monitoring sites might have caused traffic delays, which tend to build up carbon monoxide levels; or
3. Problems with carbon monoxide instrumentation might have resulted in a number of erroneously high readings. (Just 50 erroneous readings out of more than 50,000 is all that is required to produce the high number of violations that occurred in 1976.)

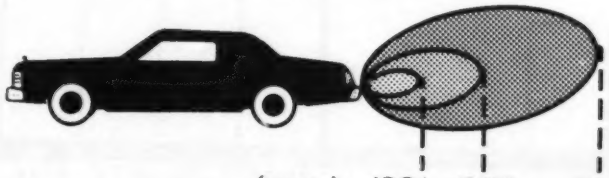
Figure 12 shows the composite trend of annual averages for nitrogen dioxide. One can see that nitrogen dioxide levels over greater St. Louis would probably never reach a composite annual average of 100 micrograms per cubic meter (the primary standard) even without emission regulations. However, while nitrogen dioxide pollution levels in the St. Louis area are quite low, this pollutant plays an important role in the formation of ozone and, if only for that reason, these levels should be kept as low as possible. In efforts to reduce nitrogen dioxide emission levels in automobiles, a major problem has arisen. As combustion efficiency is increased, thereby increasing fuel economy and lowering carbon monoxide and hydrocarbon emissions, nitrogen dioxide levels increase. This phenomena has greatly complicated the quest for a low emission automobile.

It is difficult to discuss trends in ozone levels because the generation of ozone is dependent to a great degree upon meteorological conditions. In 1975 a dramatic jump in ozone levels occurred throughout the country. As can be seen in Figure 13, the St. Louis area was similarly affected. Probably meteorological factors also played a decisive role in the sudden increase in St. Louis ozone violations in 1975. As yet there is no perceivable trend in ozone data for the greater St. Louis area. At least two or three more years of additional monitoring will be required before a trend will become discernible.

Figure 10

Maximum Allowable Emissions *

Hydrocarbons

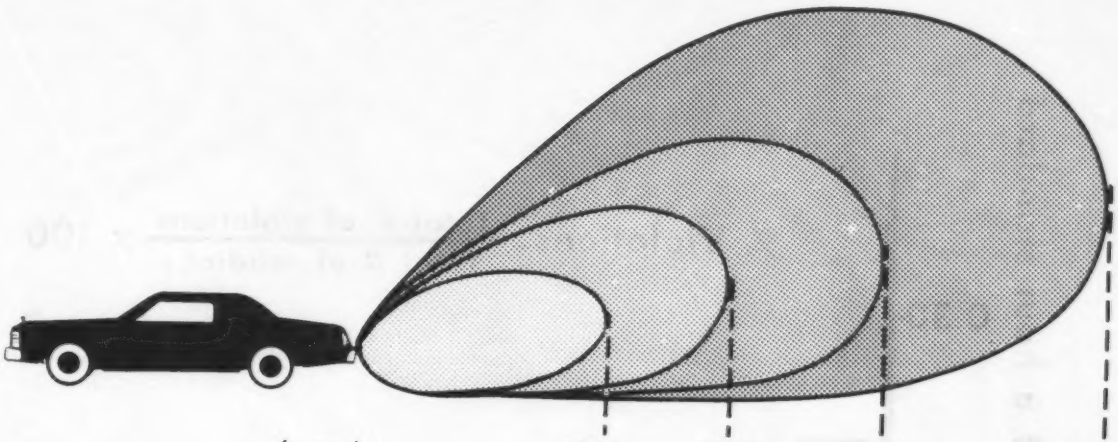


(year)	1981	1978	1972
(grams per mile)	.41	1.5	3.4

Continued
Figure 10

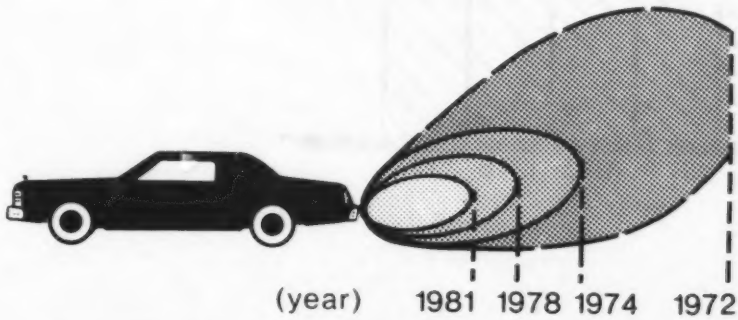
Maximum Allowable Emissions*

Carbon Monoxide



(year)	1981	1980	1978	1972
(grams per mile)	3.4	7.0	15.0	39.0

Nitrogen Oxides



(year)	1981	1978	1974	1972
(grams per mile)	1.0	2.0	3.0	No Standard

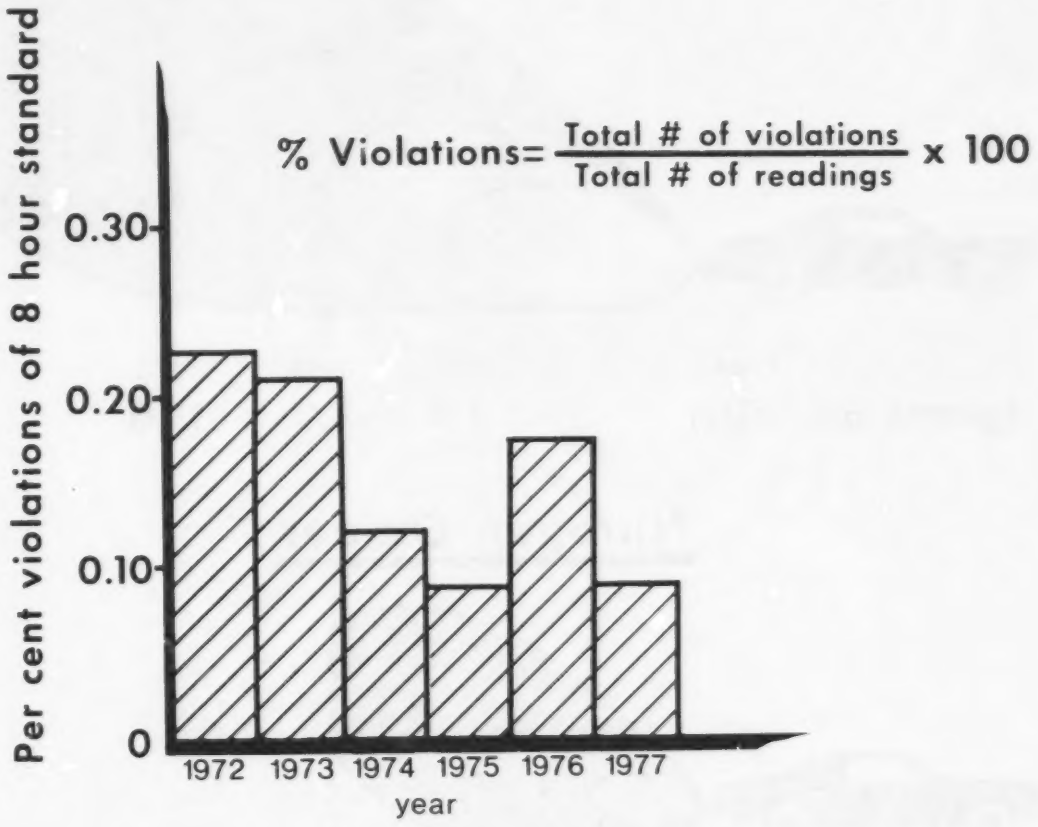
*Federal Automobile Emission Standards

EPA Region 7

Figure 11

Trend in Carbon Monoxide Levels

(Greater St. Louis Area)

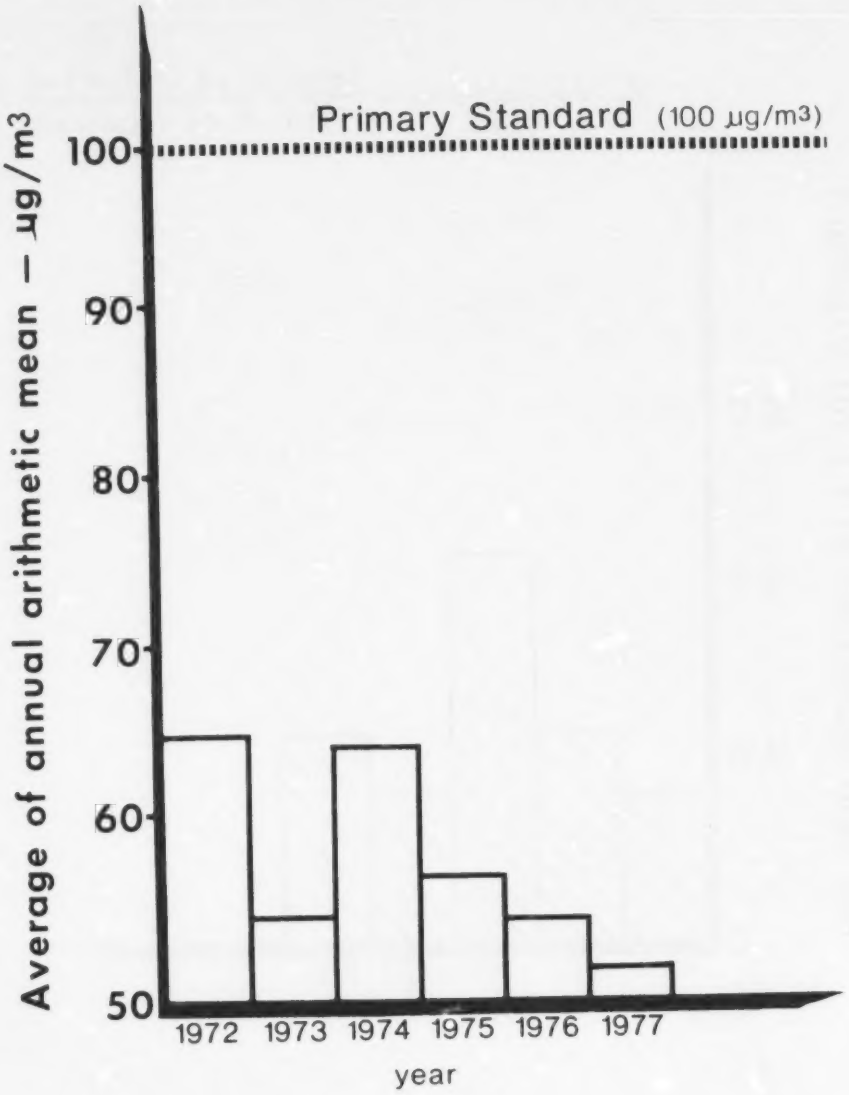


EPA
Region 7

Figure 12

Trend in Nitrogen Dioxide Levels

(Greater St. Louis Area)



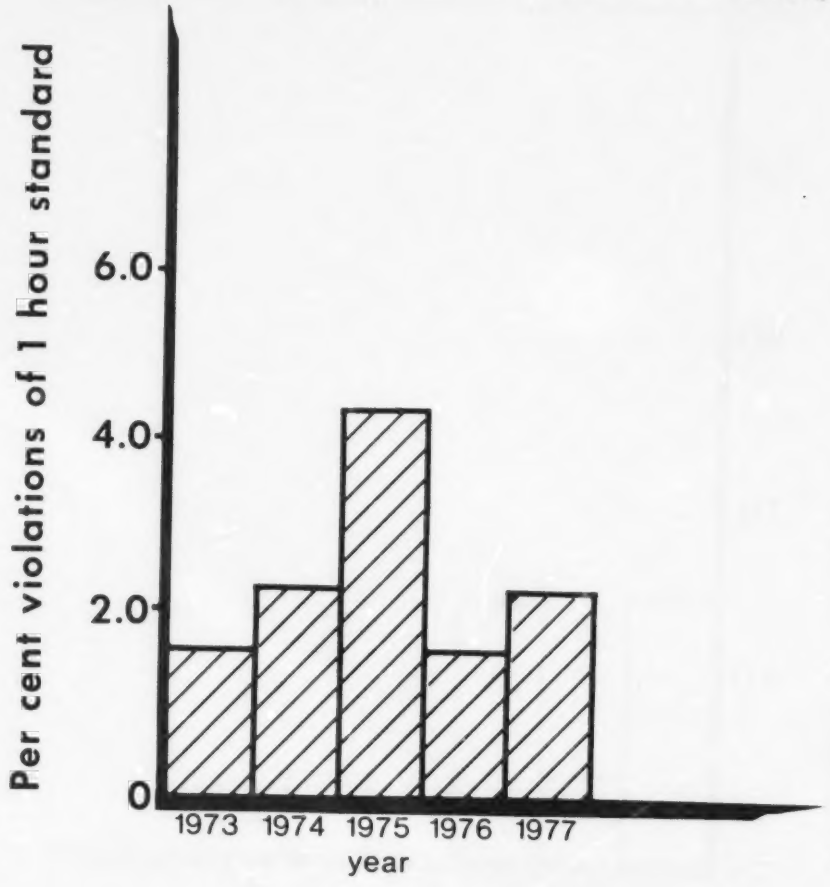
EPA
Region 7

Figure 13

Trend in Ozone Levels

(Greater St. Louis Area)

$$\% \text{ Violations} = \frac{\text{Total \# of violations}}{\text{Total \# of readings}} \times 100$$



EPA
Region 7

SUMMARY

Overall, trend data show encouraging declines in particulate, sulfur dioxide, carbon monoxide, and nitrogen dioxide levels. At the present time, however, the greater St. Louis area has attained the air quality standard for nitrogen dioxide only. In varying degrees, problem areas exist for the remaining primary pollutants:

1. *Total Suspended Particulates.* Areas in Illinois and that portion of the City of St. Louis bordering the Mississippi River are in violation of the primary standards. Lesser areas are in violation of the secondary standards. Trend data show a consistent decline in particulate levels in the City of St. Louis and St. Louis County, but additional control devices must be added to industrial plants.

2. *Sulfur Dioxide.* A small area in the southern top of St. Louis and the adjacent area in St. Louis County are the only portions of greater St. Louis considered to be in violation of the sulfur dioxide air quality standards. For the towns of Wood River and Alton in Illinois, the situation is ambiguous. A determination of the status of these two towns with regard to their compliance with the sulfur dioxide standards has been delayed until additional data have been evaluated. Trend data, however, indicate appreciable reductions in sulfur dioxide levels throughout greater St. Louis.

3. *Carbon Monoxide.* Only the City of St. Louis and the adjacent areas of St. Louis County are in violation of the carbon monoxide standards. Trend data between 1972 and 1977 indicate a reduction in violations of the standards by about 66 percent.

4. *Ozone.* The most heavily populated portions of greater St. Louis are in violation of the ozone standards. Meteorological conditions make a significant impact upon ozone levels. Hence, it is difficult to discuss ozone level trends resulting from emission reductions with the limited amount of data now available.